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ISSN: 2348-1927

RESEARCH ARTICLE

Annals of Biological Sciences
2015, 3 (3):12-19

Vitamin E ameliorates the impacts of dietary fumonisin B_1 on growth and blood profile of rabbits

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ABSTRACT

Forty-nine young female rabbits were used to evaluate the ameliorative potentials of an antioxidant, vitamin E, against the adverse impacts of fumonisin B_1 (FB_1) on growth performance and blood profile of animals. The animals were randomly assigned to control diet without FB_1 and six diets containing different concentrations of FB_1 or with antioxidant (i.e. 0.25mg FB_1, 0.5mg FB_1, 0.75mg FB_1, 0.25mg FB_1 + 100mg Vitamin E, 0.5mg FB_1 + 100mg Vitamin E, and 0.75mg FB_1 + 100mg Vitamin E) for 8 weeks. The weight changes of the rabbits generally decreased significantly ($P<0.05$) with increase in the FB_1 concentrations. The packed cell volumes obtained for animals fed diets containing ≥5.0 mg FB_1 without vitamin E were significantly ($p > 0.05$) lower than for those on all other diets. Similarly, the erythrocyte and serum total protein values of the animals fed diets containing ≥5.0 mg FB_1 without vitamin E were generally lower, while the leucocyte, alanine aminotransferase, aspartate aminotransferase and cholesterol values of the animals fed diets containing ≥5.0 mg FB_1 without vitamin E were generally higher than for those on all other diets. The potentials of the antioxidant to ameliorate the impact of the toxin on growth performance and blood parameters of the animals decreased with increase in the dietary FB_1 concentrations. Vitamin E is recommended as a nutritional strategy to alleviate the growth-depressing effect of FB_1 on animal.

Keywords: Vitamin E, Mycotoxin, Haematology, Serum biochemistry, Rabbit, Growth performance.

INTRODUCTION

Fungi produce diverse group of toxic secondary metabolites called mycotoxins. Mycotoxins are low molecular weight secondary metabolites produced by certain strains of filamentous fungi such as Aspergillus, Penicillium and Fusarium, which invade crops in the field and may grow on foods during storage under favourable conditions of temperature and humidity [1]. They are regularly implicated in toxic syndromes in animals and humans. No region of the world escapes the problem of mycotoxins and its estimated that there are about 300 harmful mycotoxins. Lawlor and Lynch [2] estimated that about 25% of the world crops contain mycotoxins. Mycotoxins have been detected in various food commodities from many parts of the world and are considered as one of the most contaminants of food and feed [3]. In the tropics, crops with large amounts of mycotoxins often have to be diverted into animal feeds, which pose a serious threat to the health and productivity of the animals, with attendant economic consequences [4].

Among such mycotoxins of significant health concern to both man and animals is fumonisin, produced by *Fusarium verticillioides*, which grows on any nourishing medium. Several naturally occurring fumonisins are known; FB_1 has

been reported to be the most abundant and most toxic, which represents approximately 70% of the total concentration in naturally contaminated foods and feeds, followed by fumonisins B_2 (FB_2) and B_3 [5, 6]. Consequently, toxicological studies on the fumonisins have been concentrated on FB_1.

Adverse effects of fumonisins on animal health and production have been recognized in intensively farmed animals such as poultry, swine and cattle. Mycotoxins may cause gastrointestinal problems [7], immune suppression [8], reproductive organ problems [9], blood abnormalities [10 - 12], disturbances in the immune system, suppression in sperm production and reproductive performance [13], and delayed sexual maturity [14].

Antioxidants have been reported [15] to reduce the toxic effects of mycotoxins in animals. Since the occurence of fumonisin B_1 is harmful to animal and human health, considerable research has been directed at finding methods to prevent the negative impact of the mycotoxin. Most of the mycotoxins, e.g. aflatoxin B_1 (AFB_1), T-2 toxin and ochratoxin A [16, 17], provoke oxygen free radical formation. For this reason, the addition of natural and synthetic antioxidants has been reported to be potentially efficacious as they are able to act as superoxide anion scavengers [18 - 21]. However, there are only few data about the positive effect of antioxidants on some important mycotoxins, including fumonisin B_1.

This study was designed to evaluate the ameliorative potentials of an antioxidant, vitamin E, against the adverse impacts of FB_1 on growth performance, haematology and serum biochemistry of female pubertal rabbit fed dietary fumonisin B_1 supplemented with or without vitamin E.

MATERIALS AND METHODS

1.1 Experimental Site and Animals

The trial was conducted at the Teaching and Research Farm of the Federal University of Technology, Akure, Nigeria. Forty nine female clinically normal matured crossed bred female rabbits aged 16 to 18 weeks were obtained from a commercial rabbit farm for the experiment. Each animal was housed individually in wire-meshed in-door cages for a period of two weeks for physiological adjustment before the commencement of the feeding study. All the animals were fed daily, and Kepromec Oral (Ivemectin®) manufactured by Kepro, B.V. of Holland with batch number 0649900 was administered through drinking water against potential ecto- and endo-parasites for two days at the recommended dosage by the manufacturer. The animals were maintained on the diets for eight weeks.

1.2 Fumonisin B_1 Production and Experimental Diets

Maize grits in 500 g quantities were placed into autoclavable polypropylene bags and soaked with 200 ml of distilled water for 2 h, then autoclaved for 1 h at 121°C and 120 kPa. The autoclaved maize grits were then cultured with a toxigenic strain of *F. verticillioides* (MRC 286) obtained from the Plant Pathology Laboratory of the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria to produce FB_1 as described previously [22]. Uncultured maize grits and the cultured maize grits were used to formulate seven diets - the control diet without FB_1 and six diets containing different concentrations of dietary FB_1 or with antioxidant (i.e. 0.25mg FB_1, 0.5mg FB_1, 0.75mg FB_1, 0.25mg FB_1 + 100mg Vitamin E, 0.5mg FB_1 + 100mg Vitamin E, and 0.75mg FB_1 + 100mg Vitamin E) per kg constituting Diets A, B, C, D, E, F, and G, respectively. Samples of homogenously mixed diets were quantified in replicates for FB_1 and other common *Fusarium* mycotoxins as described previously [23]. The concentrations of all other common *Fusarium* mycotoxins screened were below the detection limit of 0.2mg/kg for the toxins. The pelleted diets provided ~20% crude protein, 5% crude fibre and 2.9 kcal of digestible energy/g.

1.3 Feeding and watering

After two weeks of physiological adjustment period, the rabbits were randomly allocated to each of the diets (n = 7 rabbits per treatment). The design employed in the experiment was Completely Randomized Design (CRD). The animals were fed twice a day and were provided with fresh clean water and appropriately weighed feed daily. The weights of feed portions given and left uneaten after 24 h were determined. The body weight was determined weekly on a weighing scale (Ohaus Corp., Pine Brook, NJ, USA) with a precision of 0.05 g. The body weight gain of each rabbit was determined weekly as the weight difference in comparison to the weight in the previous week.

1.4 Blood collection

At the end of the experiment, blood sample was collected from the ear vein of each animal into labeled bottles, one set of which contained Ethylene diaminetetraacetic acid (EDTA), an anti-coagulant while the others were without EDTA for serum biochemistry. The blood without anti-coagulant was centrifuged and the serum separated from each blood sample was then decanted.

i. Haematological analysis

Packed Cell Volume (PCV) was determined by spinning about 75µl of each blood sample in heparinised capillary tube in a haematocrit centrifuge for about 5 minutes and read on haematocrit reader while erythrocyte (RBC) and leucocyte (WBC) counts were determined using haemocytometer method. The haemoglobin (Hb) concentration and the blood constants: mean cell haemoglobin (MCH), mean corpuscular volume (MCV) and mean corpuscular haemoglobin concentration (MCHC) were determined using cyanethaemoglobin method and appropriate formula respectively as described by Jain [24], while the differential white blood counts (neutrophils, eosinophils, basophils, lymphocytes and monocytes) were also determined [25].

ii. Serum Biochemical Analysis

The serum total protein was determined by the Biuret method using a commercial kit (Randox Laboratories Ltd, U.K.), while albumin value was obtained by bromocresol green method [26]. The globulin and albumin/globulin ratio were determined according to the method of Coles [27]. The serum creatinine and urea nitrogen were estimated by deproteinisation and Urease-Berthelot colorimetric method. Cholesterol was determined by nonane extraction and enzymatic colorimetric methods respectively using commercial test kits (Quimica Clinica Applicada, S.A.), while the serum enzymes Alanine aminotransferase (ALT) and Aspartate aminotransferase (AST) were obtained using test kits (Randox Laboratories Ltd, UK.).

1.5 Statistical analysis

The design used for the experiment is Completely Randomised Design (CRD). All the data obtained were subjected to statistical analysis using analysis of variance (ANOVA) procedure of SAS [28]. The significant treatment means were compared using the New Duncan Multiple Range test option of the same software.

RESULTS

Haematological and serum biochemical parameters of the experimental animals

The results of haematological parameters of female rabbits examined are presented in Table 1. There were significant differences ($p < 0.05$) in the values obtained for Hb, RBC, PCV and all the blood constants examined except MCHC. Apart from eosinophils, there was also significant difference ($p < 0.05$) among the leukocyte differentials examined such as lymphocyte, neutrophils and monocytes.

The values of the packed cell volume obtained for animals fed diets containing ≥5.0 mg FB_1 without vitamin E were significantly ($p < 0.05$) lower than for those on all other diets. Similarly, the erythrocyte and serum total protein values of the animals fed diets containing ≥5.0 mg FB_1 without vitamin E were generally lower, while the leucocyte, alanine aminotransferase, aspartate aminotransferase and cholesterol values of the animals fed diets containing ≥5.0 mg FB_1 without vitamin E were generally higher than for those on all other diets.

The serum biochemical response of rabbits to the experimental diets is shown in Table 2. The serum protein values examined were not significantly ($p > 0.05$) affected by the dietary treatment. The albumin, globulin, albumin-globulin ratio of rabbits fed with FB_1 supplemented with vitamin E were significantly different from those fed the control diet.

Feed intake and growth performance of the experimental animals

Table 3 shows the feed intake, weights and feed conversion ratios of rabbits fed varied concentrations of dietary FB_1 supplemented with or without vitamin E. Rabbits on Diet G had significantly ($p < 0.05$) higher feed intake than all those fed the other diets. However, the feed conversion efficiencies of rabbits fed Diets A, E, and F containing no FB_1, and 2.5 and 5.0 mg FB_1 plus vitamin E, respectively were significantly ($p < 0.05$) higher than those fed other diets containing higher concentrations of FB_1 and FB_1 plus vitamin E (i.e., Diets B, C, D, and G). Rabbits on Diets A, E, and F had higher daily weight gains than those on other diets. Animals fed Diet D containing 7.5 mg FB_1 without vitamin E had the lowest daily weight gain compared with those on the other diets.

Table 1. Haematological parameters of female rabbit fed with fumonisin B_1 supplemented with vitamin E

	Diet A Control	**Diet B** 2.5mg FB_1	**Diet C** 5.0 mg FB_1	**Diet D** 7.5 mg FB_1	**Diet E** 2.5mg FB_1 + Vitamin E	**Diet E** 5.0mg FB_1 + Vitamin E	**Diet F** 7.5mg FB_1 + Vitamin E
Packed cell volume (%)	36.25 ± 0.80^{a}	35.45 ± 2.25^{a}	32.92 ± 2.71^{b}	27.97± 1.93^{b}	36.70 ± 0.70^{a}	33.70± 2.54^{a}	37.67 ± 1.04^{a}
Haemoglobin (g/dl)	12.80 ± 0.27^{a}	11.82 ± 0.74^{a}	11.97 ± 0.97^{a}	9.32 ± 0.64^{b}	12.33± 0.23^{a}	11.23 ± 0.85^{a}	12.56 ± 0.35^{a}
Red blood cell ($x10^3$)	5.69 ± 0.09^{a}	5.53 ± 0.07^{abc}	5.14 ± 0.34^{bc}	5.12 ± 0.06^{c}	5.68 ± 0.12^{ab}	5.62 ± 0.07^{abc}	5.43 ± 0.18^{abc}
White blood cell($x10^3$)	5.84 ± 5.96	6.03 ± 0.63	6.31 ± 0.32	6.87± 0.57	5.99 ± 0.07	6.10± 0.57	6.16 ± 0.18
Neutrophils (%)	24.13 ± 1.40^{ab}	21.15 ± 1.07^{b}	23.47± 1.55^{ab}	30.15 ± 0.86^{a}	28.77 ± 1.19^{a}	25.97 ± 0.84^{ab}	23.75±4.47^{ab}
Lymphocyte (%)	57.9 ± 1.54^{b}	68.93 ± 3.41^{a}	64.25± 3.06^{ab}	66.50 ± 0.68^{a}	65.58± 0.43^{ab}	65.60 ±1.43^{ab}	63.93±3.42^{ab}
Monocyte (%)	2.48 ± 0.10^{ab}	2.52 ± 0.02^{a}	2.28 ± 0.02^{c}	2.32 ± 0.04^{bc}	2.00 ± 0.00^{c}	2.37 ± 0.09^{abc}	2.28 ± 0.06^{d}
Eosinophils (%)	4.40 ± 0.50	4.77 ± 0.54	5.10 ± 0.21	3.67± 0.44	5.23± 0.43	5.02 ± 0.75	5.25 ± 0.66
MCV (mmm^3)	71.21 ± 5.02^{a}	69.29 ± 5.00^{a}	63.23± 5.23^{ab}	50.62 ± 3.66^{b}	65.30 ± 0.69^{a}	62.49 ± 6.61^{ab}	66.34 ± 0.84^{a}
MCH (g/dl)	23.74 ± 1.67^{a}	23.10 ± 1.67^{a}	21.08± 1.79^{ab}	16.8± 1.22^{b}	21.77± 0.23^{ab}	20.83 ± 2.20^{ab}	22.11 ± 0.28^{a}
MCHC (g/dl)	33.33 ± 0.00	33.33 ± 0.00	33.33± 0.00	33.33± 0.00	33.33± 0.00	33.33 ± 0.00	33.33 ± 0.00

MCV: Mean corpuscular volume, MCHC: Mean corpuscular haemoglobin concentration, MCH: Mean corpuscular haemoglobin.
^{abcd}: Means in the same row with different superscripts are significantly ($P < 0.05$) different.

Table 2. Serum biochemistry of female rabbit fed with fumonisin B_1 supplemented with vitamin E

	Diet A Control	**Diet B** 2.5mg FB_1	**Diet C** 5.0mg FB_1	**Diet D** 7.5mg FB_1	**Diet E** 2.5mg FB_1 Vitamin E	**Diet E** 5.0mg FB_1 + Vitamin E	**Diet F** 7.5mg FB_1 + Vitamin E
Total protein (g/dl)	6.20 ± 0.15	6.07± 0.09	5.89 ± 0.12	5.58± 0.18	5.90 ± 0.15	5.87 ± 1.18	5.73 ± 0.20
Albumin (g/dl)	3.12± 0.04^{a}	3.03 ± 0.12^{b}	2.95±0.13^{b}	2.72± 0.07^{b}	3.30 ± 0.15^{a}	3.10±0.15^{ab}	2.67± 0.29^{b}
Globulin (g/dl)	2.73±0.19^{ab}	3.17 ± 0.13^{ab}	3.03±0.24^{ab}	3.35± 0.13^{a}	2.57 ± 0.33^{b}	2.80±0.10^{ab}	3.07±0.07^{ab}
ALB/GLB ratio	1.16±0.09^{ab}	0.96 ± 0.06^{ab}	0.99±0.11^{ab}	0.81± 0.05^{b}	1.34 ± 0.21^{a}	1.11±0.80^{ab}	0.89 ± 0.14^{b}
AST (U/1)	8.37 ± 0.09^{b}	8.51± 0.11^{b}	8.62±0.66^{ab}	10.50±0.15^{a}	8.50 ± 0.31^{b}	8.6 ± 0.03^{b}	8.45±0.28^{ab}
ALT (U/1)	7.37±0.09^{cd}	7.60 ± 0.60^{ab}	7.77±0.07^{cb}	10.51±0.30^{a}	7.01± 0.06^{d}	7.82 ± 0.06^{b}	7.88 ± 0.11^{b}
Urea (mol/l)	17.59± 0.75^{a}	16.90±0.38^{a}	18.13±0.32^{a}	17.5±0.38^{bc}	17.48±0.39^{a}	17.57±0.44^{a}	17.07±0.19^{a}
Cholesterol (g/dl)	33.57 ± 0.78	34.73± 0.77	35.67± 0.92	36.00± 1.12	36.57±1.60	36.53± 0.93	36.82± 1.19
Creatinine (mg/dl)	1.22 ± 0.02	1.32 ± 0.55	1.22 ± 0.02	1.33 ± 0.06	1.25 ± 0.03	1.28 ± 0.07	1.25 ± 0.03

ALT: Alanine aminotransferase, AST: Aspartate aminotransferase. ^{abcd}: Means in the same row with different superscripts are significantly ($P < 0.05$) different.

Also, the final weights of rabbits on Diets A, E, and F had higher daily weight gain while animals fed Diet D, containing 7.5 mg FB_1 without vitamin E, had the lowest daily weight gain compared with those on other diets. The total weight gained by the animals fed diets containing varied concentrations of FB_1 were only about 38.6 – 58.6 % of those on the control diet compared with 80.4 – 94.8 % for those fed diets containing FB_1 supplemented with vitamin E. Similarly, animals fed diets containing varied concentrations of FB_1 had only 37.8 – 57.8 % efficiency in feed conversion while those fed diets containing FB_1 supplemented with vitamin E had feed conversion efficiency of 70.2 – 94.8 % compared with those on the control diet.

Table 3. Performance of female rabbit fed with fumonisin B_1 supplemented with or without vitamin E

Parameters (g)	Diet A Control	Diet B 2.5mg FB_1	Diet C 5.0mg FB_1	Diet D 7.5mg FB_1	Diet E 2.5mg FB_1 Vitamin E	Diet E 5.0mg FB_1 + Vitamin E	Diet F 7.5mg FB_1 + Vitamin E	± sem
Initial weight	1099.40	1090.40	1111.30	1099.30	1103.00	1099.30	1032.30	13.56
Final weight	1487.5^{a}	1320.90^{b}	1299.90^{b}	1244.80^{c}	1459.80^{a}	1451.10^{a}	1334.60^{b}	188.42
Total weight gain	376.20^{a}	220.60^{c}	209.50^{c}	145.10^{d}	356.80^{a}	351.80^{a}	302.30^{b}	92.36
Daily weight gain	13.44^{a}	7.88^{c}	7.48^{c}	5.18^{d}	12.74^{a}	12.56^{a}	10.79^{b}	5.62
Total feed intake	1659.00^{b}	1680.00^{b}	1594.00^{b}	1765.00^{b}	1684.20^{b}	1680.00^{b}	1895^{a}	301.45
Daily feed intake	59.25^{b}	60.00^{b}	56.92^{b}	60.30^{b}	60.50^{b}	60.00^{b}	67.67^{a}	9.46
FCR*	4.40^{c}	7.61^{ab}	7.60^{ab}	11.64^{a}	4.75^{c}	4.77^{c}	6.27^{b}	2.94

**FCR – Feed conversion ratio;*

^{abcd}: Means in the same row with different superscripts are significantly ($P < 0.05$) different.

DISCUSSION

Haematological and serum chemical indices are becoming increasingly important diagnostic tools in veterinary medicine. The generally dose-dependent decrease in most haematological parameters in rabbits fed varied levels of dietary FB_1 without the antioxidant observed in this study agreed with the findings in literatures that reported changes in selected haematological parameters in pigs [11, 29], in broilers [30], in fish [31, 32], and in rabbits [10, 33] exposed to dietary fumonisin. However, these dose-dependent decreases in most haematological parameters investigated were reversed in animals fed diets supplemented with vitamin E (i.e., diets E, F and G). The results revealed that the animals exposed to feeds containing ≥ 5.0 mg FB_1 without vitamin E supplementation (Diets C and D) might have suffered significantly from the synthesis (erythropoiesis) and concentration of red blood cells (RBCs). The corresponding statistical decrease in PCV of the animals exposed to Diets C and D revealed that the animals were anaemic. The RBC, PCV, Hb and albumin values of the rabbits fed diets B, C and D generally decreased significantly ~~(P>0.05)~~ with increase in the dietary FB_1 concentrations and the potentials of the antioxidant to ameliorate the effect of the toxin on the animals also decreased with increase in the dietary FB_1 concentrations.
The PCV and RBC values of rabbits fed diets C and D were below the ranges of 33.0 – 50.0 % and 5.46 – 7.94 x 10^3 PCV and RBC reference values respectively reported by Mitruka and Rawnsley [34]. The value of haemoglobin concentration, an iron containing conjugate protein that performs the physiological function of transporting oxygen and carbondioxide, which was significantly reduced in rabbits fed Diet D as compared to the remaining treatments, falls below the normal physiological range of 10.4 – 17.4 g/dl of normal male rabbit reported by Mitruka and Rawnsley [34]. This suggests that these animals had suffered depressed respiratory capability. Although there were significant reduction in the albumin values of rabbits fed diets contaminated with FB_1, the albumin value of rabbits fed the experimental diets were within the range of 2.42 – 4.05 g/dl for normal rabbits in literatures as cited by Mitruka and Rawnsley [34]. Similarly, all the serum biochemical values for all the rabbits were within the reported literature ranges [34], except the AST and ALT values of rabbits fed Diet D which were above the literature values of 42.5 – 98.0 and 48.5 – 78.9 U/L for the respective parameters.

The significant dose-dependent decrease in protein values might be an indication of the role FB_1 could play in serum protein alterations. Reduced serum protein profiles and tissue protein synthesis in this study, as earlier reported in animals [10, 12, 35] and fish [33] exposed to *Fusarium* mycotoxins, might be a reflection of altered dietary protein metabolism, including digestibility and subsequent absorption of the nutrients in the intestine of the animals as well as biosynthesis in the body systems in animals..

The significantly lower values of albumin observed for rabbits fed Diets B, C and D (containing only FB_1 without the antioxidant) compared with those fed the control in this study may be due to deficient synthesis of albumin. Hypoproteinamia, as reported by Coles [27], is most commonly associated with a lack of proper diet or poor absorption of dietary constituents. Since all the rabbits were fed isonitrogenous diets which contain only varied

levels of FB_1, the result revealed the roles which dietary FB_1 could play in serum protein alterations, as previously observed in rabbits [10] and growing swine [12] fed dietary FB_1. Patulin, a secondary metabolite of a number of fungal species, has been reported to interfere with protein biosynthesis [36]. The results from this study suggest that dietary FB_1 could as well perturb protein biosynthesis in the animals' system as reported in fish [32].

Deficient synthesis of albumin has been reported to occur mostly when there is interference with protein digestion and absorption [27]. The results of the serum albumin obtained in this study suggest that the rabbits fed Diets B, C and D might have suffered liver impairment since the liver is the sole site of formation of albumin [27]. Also, liver has been reported to be the primary target organ for toxicity caused by fumonisins in all species tested thus far [37]. Apart from the AST and ALT values of the animals fed Diet D, containing 7.5 mg FB_1/kg without vitamin E that were higher than the AST and ALT ranges of 42.5 – 98.0 and 48.5 – 78.9 IU/L respectively, all the activities of the serum enzymes of all other rabbits examined were within the ranges reported for normal rabbit by Mitruka and Rawnsley [34]. The AST and ALT enzymes are a sensitive marker of liver damage [38]. Therefore, the increase in the serum AST and ALT activities of rabbits fed Diet D in this study might suggest an indication of liver damage.

The general decline in the total and final weight gains with increase in dietary FB_1 of animals exposed to varied concentrations of dietary FB_1 (i.e., diets B, C, and D) is an indication of the role that FB_1 could play in animal nutrition and subsequent weight gain. The reduced weight gains by rabbits with increase in the concentrations of dietary FB_1 in this study compared with those fed the control diet, may be attributed to the adverse effects of the mycotoxin on feed intake and nutrient utilization as observed in pigs fed dietary FB_1 by Gbore and Egbunike [27].

The significantly lower relative change in live weights and the significantly increased feed conversion ratio of rabbits fed Diets B, C, and D compared to controls are in agreement with results from similar studies that dietary FB_1 depressed live weight gain in rats [32, 39, - 41] and lowered feed conversion efficiency in animals [14]. Gelderblom *et al*. [39] reported that the mean body weights of BD IX rats consuming a diet containing 1 g FB_1/kg during a 4-week promotion treatment were 50% lower than those of the controls. Also, a declining relative change in body weights with increase in dietary fumonisin was reported in rabbits fed ≥ 12.30 mg fumonisin/kg for five weeks [42]. The total weight gain of 220.60, 209.50 and 145.10 g for rabbits fed diets B, C, and D, respectively, compared with 376.20 g for rabbits fed the control diet for 84 days, was similar to the report by Gbore and Akele [33] that the relative live weight gains decline with an increase in dietary fumonisin in pregnant rabbits exposed to a ≥5 mg fumonisin/kg diet. Rotter et al. [29] found out that average daily weight gain of male pigs fed a 10 ppm pure fumonisin B_1 diet through 8 weeks decreased by 11% compared to a 0 ppm diet. However, the values obtained for weight gain and FCR for rabbits fed diets E and F containing 2.5 and 5.0 mg FB_1 supplemented with vitamin E, which were similar to those on Diet A (i.e., control diet) is an indication of the ameliorative roles that the antioxidant could play on the adverse impacts of FB_1 on animal growth performance.

Various nutritional strategies have been proposed to alleviate the adverse effects of mycotoxins on livestock. Antioxidants and vitamins act on liver, tissue or cells in order to reduce the toxic effects of mycotoxins [15] due to their anti-oxidative properties which enable their participation in metabolism of all cells and delay or inhibit oxidative damage to cellular molecule as reported by Gutteridge and Halliwell [43]. The mechanisms by which vitamin E might provide this protection include its function as an antioxidant and its roles in anti-inflammatory processes [44].

CONCLUSION

This study has shown the ameliorative potentials of vitamin E on the impacts of FB_1 on rabbit growth performance and blood profile. Vitamin E at 100mg/kg of feed is recommended as a nutritional strategy, especially at concentrations of > 5.0mg/kg, to alleviate the growth-depressing effect of FB_1 on animal. The strategy of using food additives, such as antioxidants, to protect livestock from the mycotoxin may also provide effective and economical new approaches to protecting human populations.

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